REMARKS

The Pending Claims

Claims 1-3, 5, 7, 29, 30, 33, 44-48, and 58-67 currently are pending. The pending claims are directed to an ink-jet recording medium comprising a substrate having a glossy coating thereon, the glossy coating comprising fumed alumina particles and a binder.

Summary of the Office Action

The Office Action rejects claims 1-3, 7, 33, and 44-48 under 35 U.S.C. § 102(b) as allegedly anticipated by U.S. Patent No. 5,171,626 (Nagamine et al.) (hereinafter "the Nagamine '626 patent"). The Office Action also rejects claims 5, 29, 30, 58, 59, 60-63, and 64-67 under 35 U.S.C. § 103(a) as allegedly unpatentable over the Nagamine '626 patent in view of U.S. Patent No. 6,187,430 (Mukoyoshi et al.) (hereinafter "the Mukoyoshi '430 patent") and U.S. Patent No. 5,965,244 (Tang et al.) (hereinafter "the Tang '244 patent"). The Office Action further rejects claims 1-3, 5, 7, 29, 30, 33, 44-48, 58, 59, 60-63, and 64-67 under 35 U.S.C. § 103(a) as allegedly unpatentable over U.S. Patent No. 5,561,454 (Kurabayashi et al.) (hereinafter "the Kurabayashi '454 patent") in view of the combination of U.S. Patent No. 5,910,359 (Kobayashi et al.) (hereinafter "the Kobayashi '359 patent"), U.S. Patent No. 5,856,001 (Okumura et al.) (hereinafter "the Okumura '001 patent"), and one or more of: U.S. Patent No. 5,198,306 (Kruse) (hereinafter "the Kruse '306 patent"), U.S. Patent No. 5,911,855 (Dransmann et al.) (hereinafter "the Dransmann '855 patent"), U.S. Patent No. 6,238,784 (Mochizuki et al.) (hereinafter "the Mochizuki '784 patent"), the Mukoyoshi '430 patent, the Tang '244 patent, and the *Handbook of Fillers*, page 131 (2nd Ed.).

Discussion of the Section 102 and 103 Rejections over the Nagamine '626 Patent

The Office Action rejects claims 1-3, 7, 33, and 44-48 as allegedly anticipated by the Nagamine '626 patent. The Office Action further rejects claims 5, 29, 30, 58, 59, 60-63, and 64-67 as allegedly unpatentable over the Nagamine '626 patent in view of the Mukoyoshi '430 patent and the Tang '244 patent. In particular, the Office Action asserts that the Nagamine '626 patent discloses an ink-jet recording medium comprising a substrate having a glossy coating thereon. The Office Action further asserts that the Nagamine '626 patent provides that the glossy coating comprises a binder and fumed alumina particles having a surface area of about 30-80 m^2/g. The Office Action also asserts that, in view of the similarities between the ink-jet recording medium recited in the pending claims and the ink-

jet recording medium disclosed in the Nagamine '626 patent, the ink-jet recording medium disclosed in the Nagamine '626 patent would inherently exhibit a 75° specular gloss of about 15% or more, as recited in the pending claims. Applicants traverse these rejections.

The Nagamine '626 patent discloses an ink-jet recording medium comprising a substrate and a pigment layer provided on the substrate. The pigment layer comprises (i) an upper layer containing an aluminum oxide and (ii) a lower layer containing an aluminum oxide having a smaller surface area than the aluminum oxide in the upper layer (see, e.g., the Nagamine '626 patent at col. 2, lines 41-48). The Nagamine '626 patent further provides that the aluminum oxide contained within the lower layer preferably has a specific surface area of 10-90 m^2/g, and the aluminum oxide contained within the upper layer preferably has a specific surface area of 90-170 m^2/g (see, e.g., the Nagamine '626 patent at col. 4, lines 1-8 and 45-53). Thus, the Nagamine '626 patent discloses an ink-jet recording medium in which aluminum oxide particles having a surface area of about 10-90 m^2/g are contained within an intermediate pigment layer, which layer is disposed between the substrate and an upper pigment layer.

As previously noted by Applicants, the uppermost layer of the ink-jet recording medium defined by the pending claims must comprise a binder and fumed alumina particles having a surface area of about 30-80 m^2/g. However, as noted above, the Nagamine '626 patent specifically provides that the uppermost layer of the ink-jet recording medium disclosed therein comprises aluminum oxide particles having a surface area of 90-170 m^2/g. Indeed, the Nagamine '626 patent explicitly teaches that the surface area of the aluminum oxide contained within the uppermost layer should not be less than 90 m^2/g.

While the Office Action is correct in noting that Example 3 of the Nagamine '626 patent discloses an ink-jet recording medium in which the uppermost layer comprises a binder and alumina particles having a surface area of about 60 m^2/g, the alumina particles used in the recording medium set forth in Example 3 are *not fumed* alumina particles. As evidenced by the accompanying Rule 132 Declaration of Michael D. Morris and translated Showa Denko alumina brochures, the γ-alumina particles used in Example 3 (i.e., UA-5605 γ-alumina from Showa Denko Kabushiki Kaisha) are produced by calcining or sintering $Al(OH)_3$ to form γ-alumina or α-alumina. By way of contrast, fumed alumina is produced via the vapor phase pyrolysis or hydrolysis of a combustible aluminum compound (e.g., aluminum chloride). Therefore, contrary to the Office Action's assertions, the γ-alumina particles used in Example 3 are *not fumed alumina particles* and one of ordinary skill in the art would recognize the same.

Furthermore, while U.S. Patent Application Publication 2002/0164464 A1 (Monie) (hereinafter "the Monie '464 publication") may generally state that the use of fumed alumina particles in an ink-jet recording medium is disclosed in the Nagamine '626 patent, nothing within the Monie '464 publication states or evinces that all of the alumina particles used in the recording medium of the Nagamine '626 patent are fumed alumina particles. Indeed, any assertion that the blanket statement in the Monie '464 publication constitutes such evidence is contrary to both the evidence set forth in the Rule 132 Declaration of Michael D. Morris and the Nagamine '626 patent itself. For example, the Nagamine '626 patent specifically provides that "[t]he aluminum oxide referred to in the present invention can be produced by a method ... in which aluminum hydroxide ... is calcined" (the Nagamine '626 patent at col. 3, lines 43-47). Therefore, contrary to the Office Action's assertions, the statement contained in the Monie '464 publication does not prove that the γ-alumina particles used in Example 3 of the Nagamine '626 patent are fumed alumina particles.

Moreover, the Nagamine '626 patent does not, contrary to the Office Action's assertions, disclose a recording medium in which the glossy coating (i.e., uppermost layer) comprises a binder and fumed alumina particles having a surface area of about 30-80 m^2/g, as recited in the pending claims. In support of the anticipation rejection, the Office Action asserts that the Nagamine '626 patent merely provides that the alumina surface area range of 90-170 m^2/g is a preferred range and that the statement regarding the potential negative effects of using alumina having a surface area of less than 90 m^2/g encompasses the recited range. However, notwithstanding these assertions, the Office Action still fails to point out where the Nagamine '626 patent discloses a recording medium in which the glossy coating (i.e., uppermost layer) comprises a binder and fumed alumina particles having a surface area of about 30-80 m^2/g. Rather, the Office Action picks and chooses isolated portions of the Nagamine '626 patent's specification in an effort to reconstruct the claimed invention, thereby improperly using the present invention as a template for such hindsight construction and ignoring the explicit teachings of the Nagamine '626 patent. Arguments based on such piecemeal culling of a reference in an effort to modify its disclosure cannot properly support an anticipation rejection.

At most, using the Office Action's rationale that everything recited in the Nagamine '626 patent merely "preferred" and allows for alternatives, the Nagamine '626 patent discloses that *any* type of alumina particles with *any* surface area can be used in *any* layer of an ink-jet recording medium. Such a general disclosure does not properly form the basis of an anticipation rejection, where the claims in issue recite a *particular* type of alumina particles with a *particular* surface area in a *particular* layer of an ink-jet recording medium.

The Office Action appears to contend that a genus anticipates a species (or subgenus), when the case law is otherwise. *Minnesota Mining & Manufacturing Co. v. Johnson & Johnson Orthopaedics, Inc.*, 976 F.2d 1559, 1572, 24 U.S.P.Q.2d 1331, 1332 (Fed. Cir. 1992); *Corning Glass Works v. Sumitomo Elec. U.S.A.*, 868 F.2d 1251, 1262-63, 9 U.S.P.Q.2d 1962, 1970-71 (Fed. Cir. 1989); *see also, In re Baird*, 16 F.3d 380, 381-82, 29 U.S.P.Q.2d 1550, 1552 (Fed. Cir. 1994). Perhaps the Nagamine '626 patent could support an obviousness rejection with its purported general disclosure of the type, surface area, and position of alumina particles in an ink-jet recording medium. But an obviousness rejection premised on the Nagamine '626 patent would be equally inappropriate.

For example, it would not have been obvious for one of ordinary skill in the art to substitute fumed alumina particles having a surface area of about 30-80 m^2/g for the γ-alumina particles used in Example 3. As noted above, the Nagamine '626 patent specifically provides that the surface area of the aluminum oxide particles in the upper layer preferably is not less than 90 m^2/g (see, e.g., the Nagamine '626 patent at col. 4, lines 6-8). Indeed, when fumed alumina particles are used in the uppermost layer of the recording media disclosed in Nagamine '626 patent, those fumed alumina particles have a surface area of 100 m^2/g (see, e.g., the Nagamine '626 patent at col. 9, Example 4). Thus, to the extent that the Nagamine '626 patent discloses or suggests a recording medium in which the uppermost layer comprises *fumed* alumina particles, the Nagamine '626 patent teaches away from the use of fumed alumina particles with a surface area as recited in the pending claims. Instead, the Nagamine '626 patent teaches the use of alumina particles having a surface area well in excess of the surface area recited in the pending claims.

The Mukoyoshi '430 and Tang '244 patents do not remedy the deficiencies of the Nagamine '626 patent. The Mukoyoshi '430 patent generally discloses an ink-jet recording medium comprising a cast-coated ink-receiving layer containing a binder and fine silica particles with an average primary particle size of 3 to 40 nm and an average secondary particle size of 10 to 400 nm. While the Mukoyoshi '430 patent does provide that the undercoat layer of the recording medium can comprise alumina, the Mochizuki '430 patent does not teach or suggest that the ink-receiving layer of the recording medium can comprise alumina particles, much less fumed alumina particles. Moreover, the Mochizuki '430 patent's disclosure relating to particle size is limited to the particle size of the fine silica particles contained in the ink-receiving layer of the recording medium. There is nothing within the cited references or the knowledge generally available to those of ordinary skill in the art that would have suggested that, at the time of invention, the particle size ranges disclosed in the Mochizuki '430 patent for silica particles would have been suitable particle

size ranges for alumina particles. Indeed, as evidenced by the accompanying Rule 132 Declaration of Michael D. Morris, there is nothing within the art that would suggest that a physical characteristic that is suitable for silica particles, such as the silica particles of the Mukoyoshi '430 patent, would also be suitable for alumina particles in the context of ink-jet recording mediua in view of the differences in composition and chemistry between the two types of particles.

The Tang '244 patent relates to a printing medium for ink-jet printing comprising a coating layer that comprises porous particles, colloidal particles, and a resin binder. The colloidal particles are greater in size than the size of the pores of the porous particles, but smaller than the interstitial pores created by the porous particles. Despite its disclosure relating to the use of alumina as the porous particles, the Tang '244 patent does not disclose or suggest a recording medium comprising fumed alumina particles. Furthermore, as can be seen from the Figure of the Tang '244 patent, the porous particles used in the disclosed recording medium desirably are substantially spherical in shape, as opposed to having the chain-like aggregate structure of fumed alumina particles. Insofar as neither the Mukoyoshi '430 patent nor the Tang '244 patent discloses or suggests a recording medium comprising fumed alumina, the combination of the Nagamine '626, Mukoyoshi '430, and Tang '244 patents cannot properly be considered to disclose or suggest a recording medium in which the glossy coating (i.e., uppermost layer) comprises a binder and fumed alumina particles having a surface area of about 30-80 m^2/g, as recited in the pending claims.

In view of the foregoing, the invention defined by the pending claims is neither anticipated by nor obvious over the Nagamine '626 patent, alone or in combination with the Mukoyoshi '430 patent and/or the Tang '244 patent. Indeed, none of the cited references discloses or suggests a recording medium comprising a substrate having a glossy coating thereon, wherein the glossy coating comprises a binder and fumed alumina particles having a surface area of about 30-80 m^2/g, as recited in the pending claims. The Section 102 and 103 rejections over the Nagamine '626, Mukoyoshi '430, and Tang '244 patents are improper and, therefore, should be withdrawn.

Discussion of the Section 103 Rejection over the Kurabayashi '454 Patent

The Office Action rejects claims 1-3, 5, 7, 29, 30, 33, 44-48, 58, 59, 60-63, and 64-67 as allegedly unpatentable the Kurabayashi '454 patent in view of the combination of the Kobayashi '359 patent, the Okumura '001 patent, and one or more of: the Kruse '306 patent, the Dransmann '855 patent, the Mochizuki '784 patent, the Mukoyoshi '430 patent, the Tang '244 patent, and the *Handbook of Fillers*. In particular, the Office Action asserts that the

Kurabayashi '454 patent discloses a recording medium comprising a substrate having a glossy coating thereon, the glossy coating comprising a binder and alumina particles. The Office Action acknowledges that the Kurabayashi '454 patent fails to teach or suggest a recording medium comprising a glossy coating having the specular gloss recited in the pending claims, but asserts that it would have been obvious for one of ordinary skill in the art to modify the recording medium disclosed therein in such a way as to arrive at the invention defined by the pending claims in view of the Kobayahsi '359 patent. The Office Action further asserts that, in view of the teachings of the Okumura '001 patent, it would have been obvious for one of ordinary skill in the art to modify the recording medium disclosed in the Kurabayashi '454 patent by selecting alumina particles having the surface area recited in the pending claims. Lastly, the Office Action acknowledges that none of the aforementioned references teaches or suggests a recording medium comprising *fumed* alumina particles, but asserts that such modification of the recording medium disclosed in the Kurabayashi '454 patent would have been obvious to one of ordinary skill in the art in view of the Kruse '306 patent, the Dransmann '855 patent, the Mochizuki '784 patent, and the *Handbook of Fillers*, alone or in combination. Applicants traverse this rejection.

The Kurabayashi '454 patent generally discloses an ink-jet recording medium comprising a base and a surface layer provided on the base. The surface layer comprises a binder and a pigment, and the Kurabayashi '454 patent further provides that suitable pigments include alumina (see, e.g., the Kurabayashi '454 patent at col. 3, lines 39-42). However, as acknowledged by the Office Action, the Kurabayashi '454 patent does not disclose or suggest a recording medium comprising *fumed* alumina particles having a surface area of 30-80 m^2/g, nor does it disclose or suggest a recording medium having a 75° specular gloss of about 15% or more, as recited in the pending claims.

The Kobayashi '359 patent generally discloses an ink-jet recording medium comprising a transparent support and a transparent colorant-receptive layer, which layer is composed of crosslinked polymer particles. While the Kobayashi '359 patent does provide that small amounts of inorganic particles can be added to the colorant-receptive layer as a matting agent, it does not list fumed alumina as a suitable additive. Thus, the Kobayashi '359 patent cannot properly be considered to teach or suggest a recording medium comprising alumina particles, much less fumed alumina particles having a surface area of 30-80 m^2/g, as recited in the pending claims.

The Okumura '001 patent discloses an ink-jet recording medium comprising an ink-receiving layer formed on a substrate, wherein the ink-receiving layer contains xerogel pigment particles. The Okumura patent further provides that the xerogel particles can be

formed from hydrogel-forming materials, such as aluminum hydroxide, alumina, silica, and magnesium hydroxide. While the Okumura '001 patent does disclose a broad surface area range for the xerogel particles, which overlaps with the range recited in the pending claims, such a broad teaching for xerogel particles would not have motivated one of ordinary skill in the art to modify the recording medium disclosed in the Kurabayashi '454 patent by using alumina particles having a surface area of about 30-80 m^2/g. Indeed, xerogel particles are loosely agglomerated particles formed from metal oxide gels that have been dried and where the gel structure has been allowed to collapse. By way of contrast, as set forth in the Rule 132 Declaration of Michael D. Morris, *fumed* alumina particles are aggregates of smaller primary particles connected in a three-dimensional chain-like structure. Thus, the particles are structurally quite different, and the Okumura '001 patent's teaching regarding suitable surface areas for xerogels cannot, without further motivation, be applied to fumed alumina particles. Moreover, the Okumura '001 patent discloses xerogel particles having a wide range of surface areas (e.g. 25 to 400 m^2/g, preferably about 100 to 400 m^2/g). However, there is nothing within the Okumura '001 patent that would motivate one of ordinary skill in the art to select a particle having a surface area of about 30-80 m^2/g, as recited in the pending claims. Indeed, one of ordinary skill in the art would have been motivated to use a higher surface area particle in view of the fact that all of the Okumura '001 patent's examples utilize relatively high surface area particles and that the range of about 100 to 400 m^2/g is indicated as preferred. Thus, the Okumura '001 patent cannot properly be considered to teach or suggest a recording medium comprising fumed alumina particles having a surface area of about 30-80 m^2/g.

As noted above, the Office Action acknowledges that the aforementioned references, alone or in combination, fail to teach or suggest a recording medium comprising *fumed* alumina particles. However, the Office Action asserts that such a recording medium would have been obvious to one of ordinary skill in the art in view of the Kruse '306 patent, the Dransmann '855 patent, the Mochizuki '784 patent, and the *Handbook of Fillers*, alone or in combination. The Kruse '306 patent merely discloses the use of alumina in the surface layer of the transparency to improve the "pencil tooth," and does not contain any teaching or suggestion regarding the alleged equivalence of fumed alumina and other types of alumina in coatings applied to ink-jet recording media. The Mochizuki '784 patent generally discloses a recording medium comprising a support and an ink-receiving layer, which comprises a binder and solid fine particles, provided thereon. The Mochizuki '784 patent further provides a long list of suitable solid fine particles, which includes alumina, colloidal alumina, hydrated alumina, and aluminum hydroxide (see, e.g., the Mochizuki '784 patent at col. 3, lines 5-19).

The Dransmann '855 patent also discloses an ink-jet recording medium comprising a support, a dye-receiving coating, and an upper coating comprising particles of a porous inorganic pigment exhibiting cationic charge centers (see, the Dransmann '855 patent at col. 2, lines 42-46). The Dransmann '855 patent further provides that suitable particles include aluminum oxides, pyrogenic aluminum hydroxides, and aluminum oxide hydrates (see, e.g., the Dransmann '855 patent at col. 2, lines 47-50). However, contrary to the Office Action's assertions, the Mochizuki '784 and the Dransmann '855 patents do not teach or suggest that fumed alumina is equivalent to other types of alumina in coatings applied to ink-jet recording media. Indeed, the terms "hydrated alumina" and "pyrogenic aluminum hydroxides" refer to a true hydroxide of aluminum (i.e., $Al(OH)_3$) that is chemically distinct from alumina, which has the chemical formula Al_2O_3 (see, e.g., *The Merck Index*, pp. 61 and 62 (12th Ed.) (previously submitted)). Lastly, the excerpted portion of the *Handbook of Fillers* merely provides that the terms "pyrogenic silica" and "fumed silica" refer to the same type of silica. However, the alleged equivalence of the terms "pyrogenic" and "fumed" is irrelevant insofar as the cited references only teach "pyrogenic aluminum hydroxides" (see, e.g., the Dransmann '855 patent at col. 2, lines 476-50), which compounds are chemically distinct from *alumina*, much less *fumed alumina*. Thus, none of the cited references even mentions *fumed* alumina, much less teaches or suggests that it is equivalent to other types of alumina in coatings applied to ink-jet recording media.

In further support of the obviousness rejection, the Office Action asserts that fumed alumina is merely alumina made by a specific process and its structure is indistinguishable from other forms of alumina. While the Office Action is correct in its assertion that the term "fumed alumina" refers to alumina made in a particular manner, the Office Action is not correct in its assertion that the structure of fumed alumina is indistinguishable from other forms of alumina. In particular, as evidenced by the accompanying Rule 132 Declaration of Michael D. Morris, fumed alumina particles consists of a plurality of discrete, substantially spherical primary particles that are fused together to form a three-dimensional, chain-like aggregate. The Rule 132 declaration further evinces that the structure of fumed alumina is significantly different from the structure of colloidal alumina particles formed by other processes, which typically consist of a plurality of discrete, substantially spherical primary particles that exist as discrete primary particles or are loosely agglomerated to form a network of primary particles. Thus, contrary to the Office Action's assertions, the structure of fumed alumina particles is significantly different from the structure of other colloidal alumina particles. Therefore, fumed alumina particles cannot properly be deemed equivalent to other forms of alumina such that it would have been obvious to one of ordinary skill in the art to

modify the recording medium disclosed in the cited references in such a way as to arrive at the invention defined by the pending claims.

In view of the foregoing, the invention defined by the pending claims is neither anticipated by nor obvious over the Kurabayashi '454 patent, alone or in combination with the Kobayashi '359 patent, the Okumura '001 patent, and one or more of: the Kruse '306 patent, the Dransmann '855 patent, the Mochizuki '784 patent, the Mukoyoshi '430 patent, the Tang '244 patent, and the *Handbook of Fillers*. In particular, none of the cited references teaches or suggests a recording medium comprising a substrate having a glossy coating thereon, wherein the glossy coating comprises a binder and fumed alumina particles having a surface area of about 30-80 m^2/g. The Section 103 rejection of the pending claims is improper and, therefore, should be withdrawn.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

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Date: March 10, 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Darsillo et al.

Group Art Unit: 1773

Application No.: 09/670,118

Filed: September 26, 2000

Examiner: Kevin M. Bernatz

For: RECORDING MEDIUM

DECLARATION UNDER 37 C.F.R. § 1.132 OF MICHAEL D. MORRIS

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, Michael D. Morris, hereby declare that:

1. I have a Doctor of Philosophy (Ph.D.) in Chemistry from the University of Southampton, United Kingdom, and I have over seven years of experience working with metal oxides, including their use in recording media. I am currently employed by Cabot Corporation (the assignee of the present application) as a Project Leader and Research Chemist.

2. I have reviewed and am familiar with the subject matter claimed in the present application.

3. I have reviewed U.S. Patent No. 5,171,626 (Nagamine et al.) (hereinafter "the Nagamine '626 patent") and U.S. Patent No. 6,187,430 (Mukoyoshi et al.) (hereinafter "the Mukoyoshi '430 patent").

4. The Nagamine '626 patent discloses an ink-jet recording medium comprising a substrate and a pigment layer provided on the substrate. The pigment layer comprises (i) an upper layer containing an aluminum oxide and (ii) a lower layer containing an aluminum oxide having a smaller surface area than the aluminum oxide in the upper layer. The Nagamine '626 patent further provides that the aluminum oxide contained within the lower layer preferably has a specific surface area of 10-90 m^2/g, and the aluminum oxide contained within the upper layer preferably has a specific surface area of 90-170 m^2/g.

5. Example 3 of the Nagamine '626 patent discloses an ink-jet recording medium in which the uppermost layer comprises a binder and alumina particles having a surface area of about 60 m^2/g and an average particle diameter of 0.05 μm. The Nagamine '626 patent further provides that the alumina particles used in the uppermost layer of the recording medium of Example 3 are γ-alumina particles (i.e., particles of alumina in the gamma crystalline phase), namely UA-5605 alumina manufactured by Showa Denko Kabushiki Kaisha.

6. The attached translation of a Showa Denko alumina product brochure indicates that Showa Denko's alumina products, including UA-5605 alumina, are produced by calcining or sintering $Al(OH)_3$ to form γ-alumina or α-alumina.

7. "Fumed alumina" refers to alumina particles that are produced via the vapor phase pyrolysis or hydrolysis of a combustible aluminum compound (e.g., aluminum chloride).

8. While fumed alumina particles are a species of colloidal alumina particles, fumed alumina particles have a structure that is significantly different from colloidal alumina particles formed by other processes, such as the calcining or sintering of $Al(OH)_3$.

9. In particular, fumed alumina particles consist of a plurality of discrete, substantially spherical primary particles that are fused together to form a three-dimensional, chain-like aggregate. These aggregates are formed during the pyrolysis or hydrolysis of the combustible aluminum compound, and, therefore, the bond between individual primary particles is very strong. Indeed, fumed metal oxide aggregates (e.g., fumed alumina aggregates) typically can only be broken up by the application of a considerable mechanical force.

10. By way of contrast, many other types of colloidal alumina particles, such as calcined alumina particles and alumina xerogel paricles, consist of a plurality of discrete, substantially spherical primary particles that exist as discrete primary particles or are loosely agglomerated to form a network of primary particles. These agglomerates can be held together by weak interactions between the particles, such that the agglomerates can be broken up by merely dispersing the particles in a liquid medium (e.g., water) or with the application of little mechanical force.

11. Within the art encompassing ink-jet recording media, it is not reasonable to assume that physical characteristics that are deemed to be desirable for one type of particle (e.g., silica) would also be suitable for other types of particles (e.g., alumina) due to the differences in composition and chemistry between the particles. Indeed, the composition and chemistry of a particle (e.g., a fumed metal oxide particle) typically is considered to be of primary importance in assessing its suitability for use in an ink-jet recording medium and the effects stemming from its use. Therefore, it would not have been reasonable to assume, at the time of invention, that the particle size ranges set forth in, for example, the Mochizuki '430 patent for silica particles would have been suitable particle size ranges for alumina particles in the context of ink-jet recording media.

12. I hereby declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: March 10, 2004

Michael D. Morris, PhD

化学品、耐火物、セラミックス、製紙、プラスチックスなど幅広い分野で使用されているアルミナ製品群。
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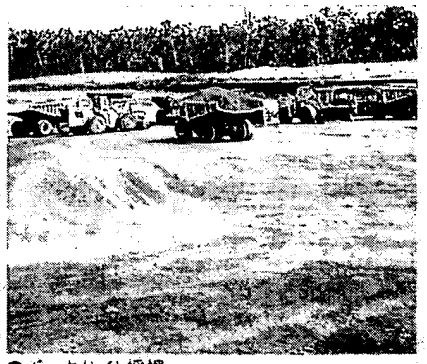

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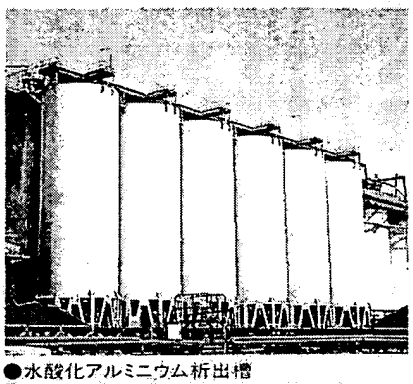
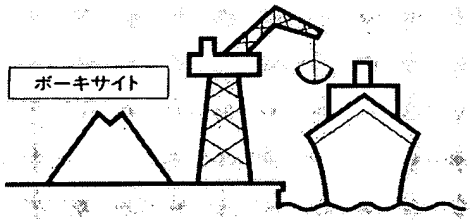
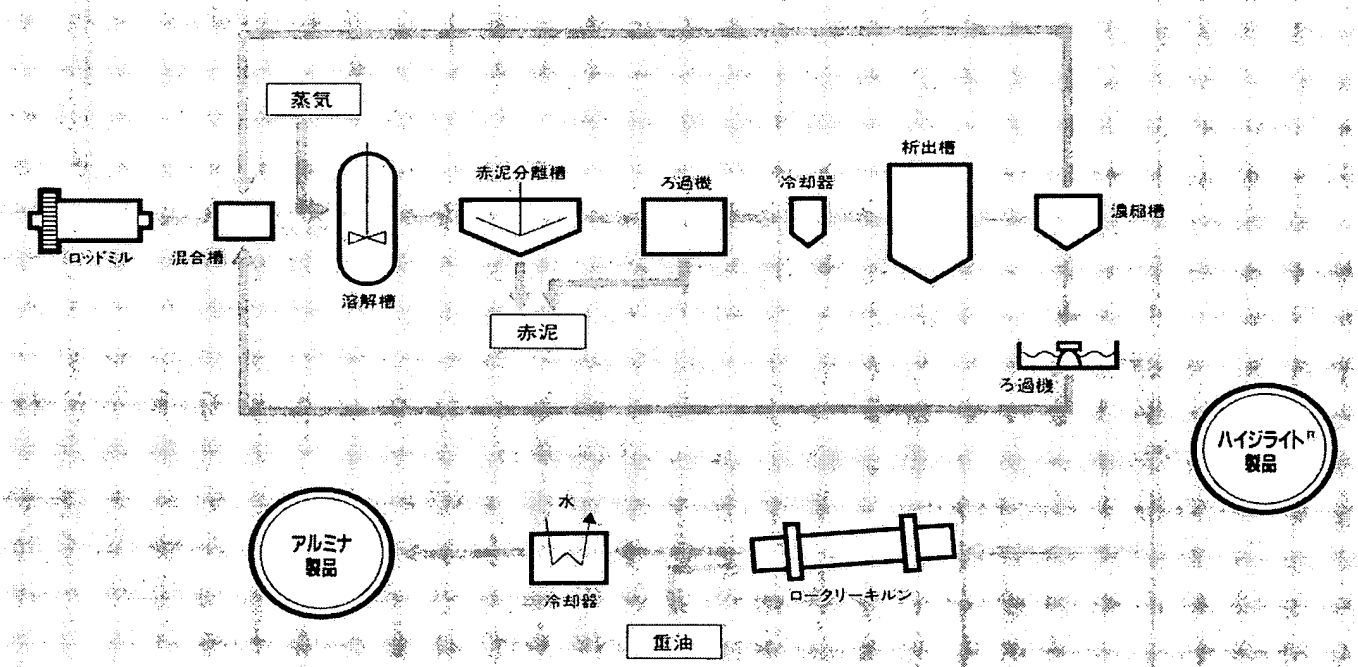
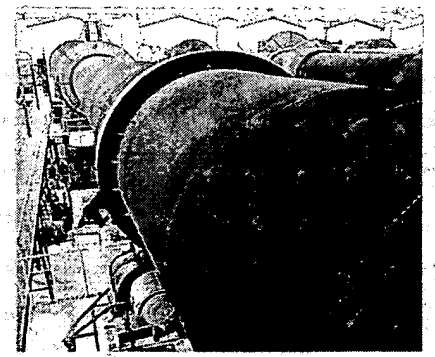


●水酸化アルミニウム析出槽

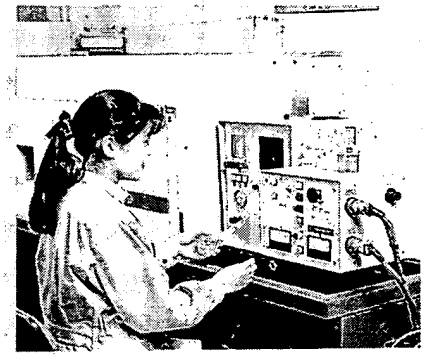






●アルミナ焼成キルン

●製造管理室



●製品検査

アルミナ
(酸化アルミニウム)

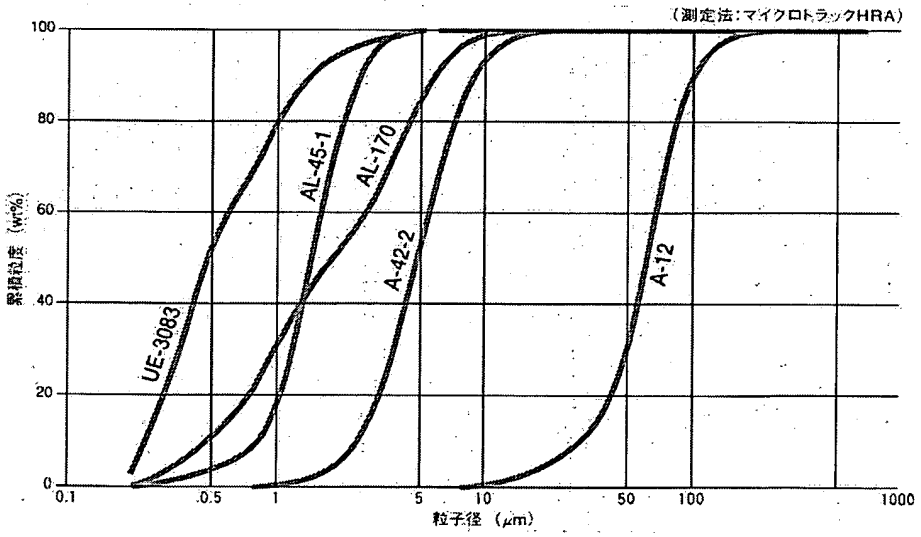
アルミナは水酸化アルミニウムを焼成することによってできる白色粉末結晶です。アルミナの結晶変態は数多く知られていますが、安定で最も広く利用されているのはαアルミナです。αアルミナは融点が高く、熱的に安定であり、ダイヤモンド・BN・SiCに次いで硬いうえ、電気絶縁抵抗が高く、酸・アルカリに安定です。従って、耐火材、碍子、スパークプラグ、IC基板・ICパッケージ、研削・研磨材、耐熱・耐薬品磁器など幅広い用途に利用されています。それらの用途に応じ、α結晶粒径の大きさとその分布および不純物レベルをコントロールした各種の製品群を用意しております。

■αアルミナの特性

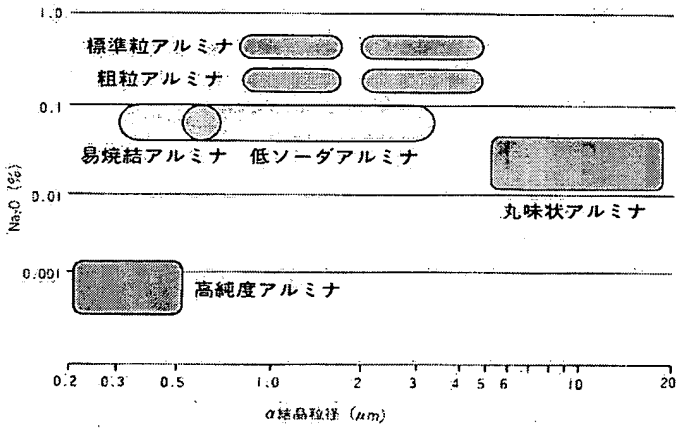
鉱物名		コランダム	誘電率	CII	11.5	at25°C
結晶系		六方晶系 a:4.67、c:13.00×10^{-10}m		C⊥	9.3	10^3~10^{10} Hz
真比重		3.98	耐電圧		4.8×10^5 V/cm	
融点		2053°C	体積固有抵抗		10^{15}Ω/cm	
熱伝導率		36J/m・sec・°C	屈折率		1.76	
比熱		750J/kg・°C	硬度	モース	12	
熱膨張係数	CII	6.6×10^{-6}/°C		ビッカース	2.2×10^4 MPa	
	C⊥	5.3×10^{-6}/°C	ヤング率		4.7×10^5 MPa	
誘電正接		1×10^{-5} at10^3Hz	圧縮強さ		2940 MPa	

既存化学物質番号(化審法) 1-23

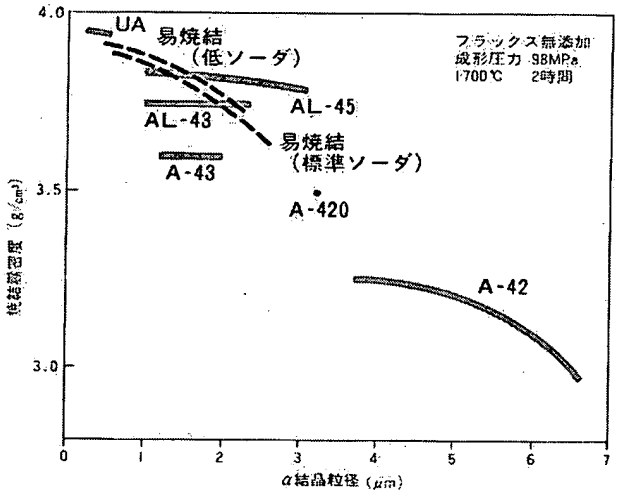
■アルミナの粒度分布



■各種アルミナ製品の位置づけ



■各種アルミナ製品の焼結特性



■アルミナの用途

銘柄＼用途		セラミックス											耐火物						研磨			その他							
		理化学磁器	耐摩耗磁器	匣鉢	碍子	スパークプラグ	電子部品	セラミック工具	透光性多結晶体	単結晶体	セラミックフィルター		電融アルミナ	焼結アルミナ	合成スピネル	定形耐火物	不定形耐火物	セラミックファイバー	硬質材研磨	軟質材研磨	精密研磨		硝子原料	溶接棒	造泥剤	敷粉・離型剤	触媒	樹脂フィラー	塗料	
標準粒	A-12			○	○								◎		◎	○		◎					◎		◎	○				
標準粒	A-13シリーズ	○	○	○	○									○	○			○					○	◎	○					
粗粒	A-12C												◎		○			◎								○				
粗粒	A-14C												○	◎	○			◎												
細粒	A-42シリーズ		○	◎	◎										◎	◎	◎		○				○	○	○	○	○	○	◎	
細粒	A-420	○	○	○			○									○	○										○			
微粒	A-43シリーズ	○		◎			○																							
微粒	A-50シリーズ																		◎	◎	○						○			
低ソーダ	AL-13シリーズ	◎	◎			○	○																							
低ソーダ	AL-13KT																									◎		○		
低ソーダ	AL-15, AL-17シリーズ	◎			○	◎	◎	○																						
低ソーダ	AL-43シリーズ	○	○				○																					◎		
低ソーダ	AL-45シリーズ	○				○	○																					◎		
易焼結性	AL-150SG	○					○																							
易焼結性	AL-160SG	○	◎				○	◎			○					○	○	○		○							○	○	○	
易焼結性	UEシリーズ	○	◎				○	◎			○					○	○	○		○							○	○	○	
易焼結性	AL-170			◎			○	○								○	◎											○		
易焼結性	A-172、A-173																◎													
易焼結性	A-161SG	○	○					○									◎													
高純度	UAシリーズ						◎	◎	◎	◎	○									○	◎						○	◎	○	
丸味状	ASシリーズ										◎															◎		◎		

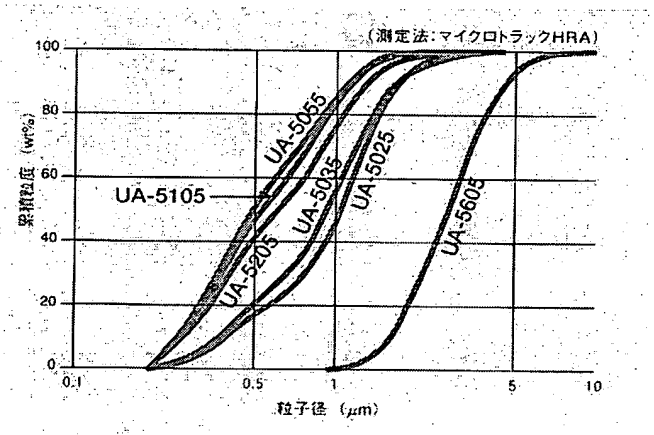
高純度アルミナ

当社の高純度アルミナは$A\ell_2O_3$ 99.995%以上と極めて高純度であり、かつ粒径がサブミクロンの均一な超微粉であることから、表面平滑性に優れ、均質で高強度、高密度の焼結体が低い焼結温度で得られます。また、高純度、超微粉の特徴を活かした各種用途分野で、優れた機能を発揮します。

■用　途

(1)透光性磁器：高圧ナトリウムランプ発光管、EP-ROM窓
(2)単結晶：サファイア、ルビー、YAG
(3)高強度アルミナセラミックス：IC基板、ICパッケージ、切削工具、高純度ルツボ、糸道、スパッタリングターゲット
(4)研磨材：ガラス・金属・半導体・プラスチックの研磨材、磁気テープ、研磨テープ
(5)その他：蒸着材料、蛍光材料、特殊硝子原料、複合材料、樹脂用フィラー

■高純度アルミナの粒度分布



■化学分析値(代表値、各グレード共通)

(単位 ppm)

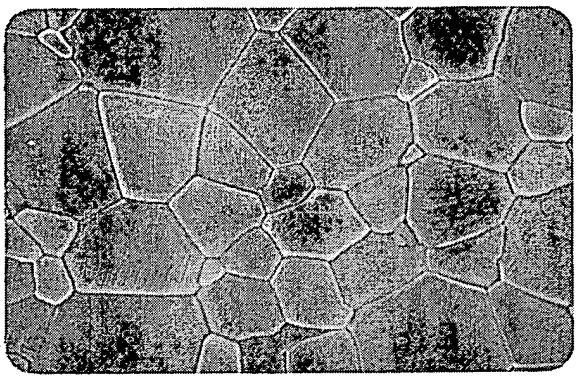
Na	K	Ca	Mg	Fe	Si	Ga	Cr
12	7	1	1	3	8	2	1

■品質代表特性値

品質項目＼品名		未粉砕品		粉砕品				
		UA-5050	UA-5100	UA-5035	UA-5055	UA-5105	UA-5205	UA-5605
結晶形		α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	γ-Al_2O_3
BET比表面積(㎡/g)		5	10	3	5	10	20	60
真比重		3.95	3.88	3.97	3.95	3.88	3.80	3.50
嵩密度(g/cm)	軽装	0.4	0.3	0.5	0.5	0.4	0.3	0.2
	重装	0.8	0.7	1.1	1	0.9	0.7	0.4
加圧嵩密度 (g/cm)		1.83	1.80	2.00	1.96	1.90	1.72	1.20
結晶粒子径 (μm)		0.3	0.25	0.4	0.3	0.3	0.1	0.05
粒度分布	平均粒子径 (μm)	—	—	0.9	0.5	0.5	0.6	2.8
	—5μm (%)	—	—	100	100	100	100	97
	—3μm (%)	—	—	99	100	100	100	82
	—2μm (%)	—	—	98	100	100	100	57
	—1μm (%)	—	—	93	99	99	97	22
	—0.5μm (%)	—	—	55	84	82	75	0
吸油量 (mℓ/100g)		—	—	15	23	23	40	63
焼結試験	MgO 500ppm添加 線収縮率(%)	—	—	19.1	20.1	21.0	—	—
	MgO 500ppm添加 嵩密度(g/cm)	—	—	3.92	3.96	3.96	—	—
	アルミナ単味 線収縮率(%)	—	—	18.9	19.9	20.8	—	—
	アルミナ単味 嵩密度(g/cm)	—	—	3.88	3.92	3.94	—	—

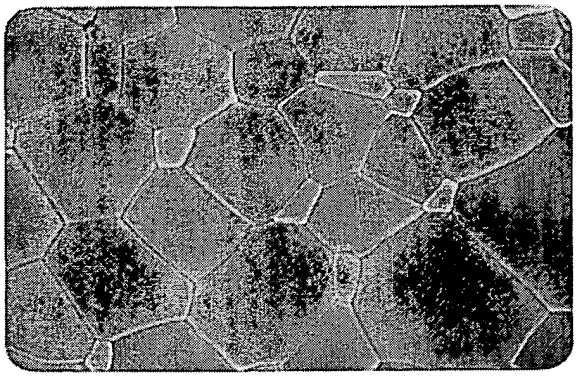
※1600℃ 2時間焼成

■焼結体組織



UA-5055
アルミナ単味1600℃ 2時間保持

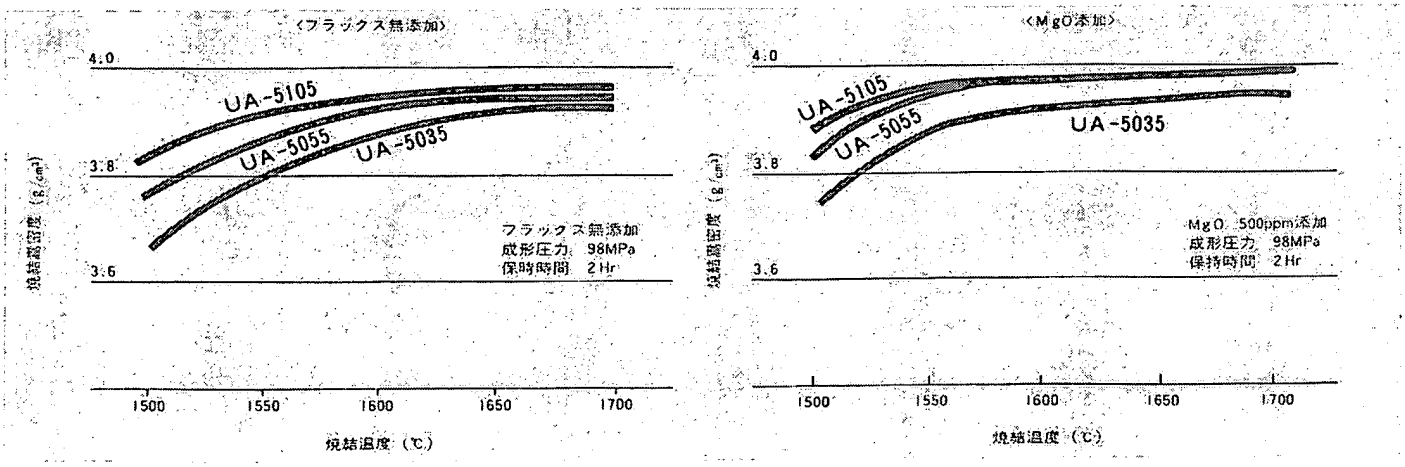
5 μm



UA-5105
アルミナ単味1600℃ 2時間保持

5 μm

■高純度アルミナの焼結特性



[Showa Denko Alumina Brochure]

Showa Denko Alumina

Alumina products used in a wide range of fields such as chemical products, fireproof materials, ceramics, papermaking, plastics, etc.

Showa Denko Co., (Ltd.) started production of alumina in Showa 8 [1933] based on having the first domestic technology, and for more than a half century, it has contributed to the supply of alumina both domestically and internationally.

During this time, technical development has been stressed, consistently, and the newest equipment is used and increase in the variety of products and improved quality are promoted.

Based on long years of experience as a base material manufacturer, higher quality products are being pursued to meet a variety of requirements and at the same time, development of products that can be used widely in a variety of industries based on unique technology is planned.

DEVELOPING FUTURE MATERIALS WITH INGENIOUS TECHNOLOGY

(With use of the products described in the catalogue)

The characteristic value described in the catalogue is an average value and is not a guaranteed value.

Aluminum hydroxide, alumina, and sodium aluminate are to be used for industrial purposes only.

With application of sodium hydroxide and alumina, use dust collectors and wear protective dust masks, etc.

Sodium aluminate falls under "Toxic Substance and Deleterious Substance Assignment" Article II, No. 68.

Read the Material Safety Data Sheet (MSDS) before handling our products. Contact us for further information.

Those used are application examples and may not work under the production conditions of the client, and final judgment should be made by the client.

(Change of content)

Please note that changes in the content of the catalogue may occur without notification.

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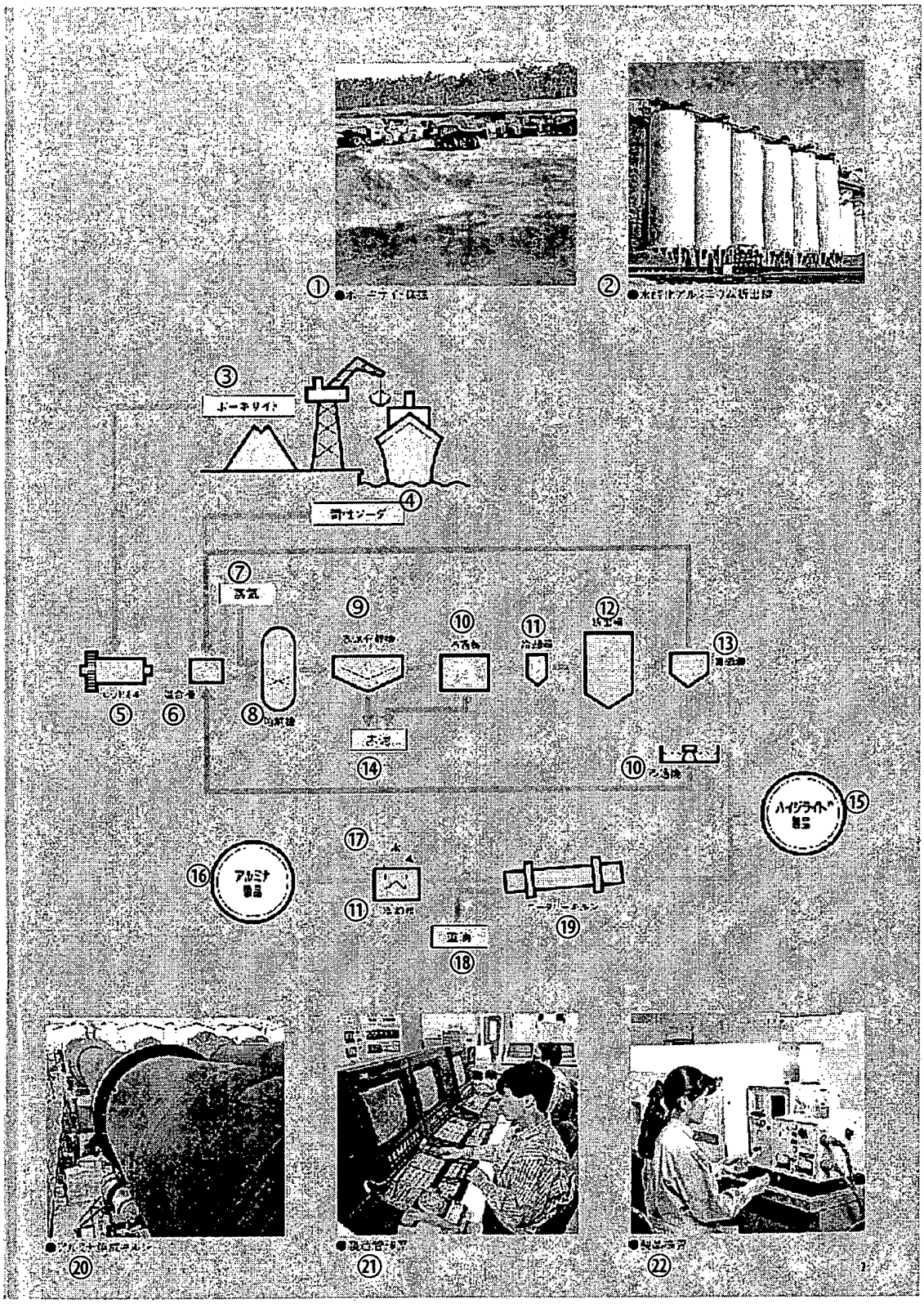
①
②
③
ボーキサイト
④
苛性ソーダ
⑦
蒸気
⑨
⑩
⑪
⑫
⑬
⑤
⑥
⑧
⑭
⑮
ハイジライト
製品
⑯
アルミナ
製品
⑰
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[Key to previous page:]

1 Bauxite drilling
2 Aluminum hydroxide storage tanks
3 Bauxite
4 Caustic soda
5 Rod mill
6 Mixing tank
7 Steam
8 Dissolving tank
9 Red sludge separation tank
10 Filter
11 Cooler
12 Storage tank
13 Condenser
14 Red sludge
15 Hydrargillite product
16 Alumina product
17 Water
18 Heavy oil
19 Rotary kiln
20 Alumina baking kiln
21 Production control room
22 Product testing

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Alumina (Aluminum oxide)

Alumina is a white powder crystal produced by sintering aluminum hydroxide. Many different modifications of alumina are known, but the one that is most stable and widely used is α-alumina. α-alumina has a high melting point, is thermally stable, and has a hardness near that of diamond, BN, and SiC, and furthermore, it has high electrical insulation resistance and stability against acid and alkali. Therefore, it is used widely in a variety of fields such as fire proofing materials, glass, spark plugs, IC boards and IC packages, polishing and abrasive materials, and heat resistant and chemical resistant ceramics. Many different product groups with different α crystal particle diameter and distribution and impurity content are available depending on the application.

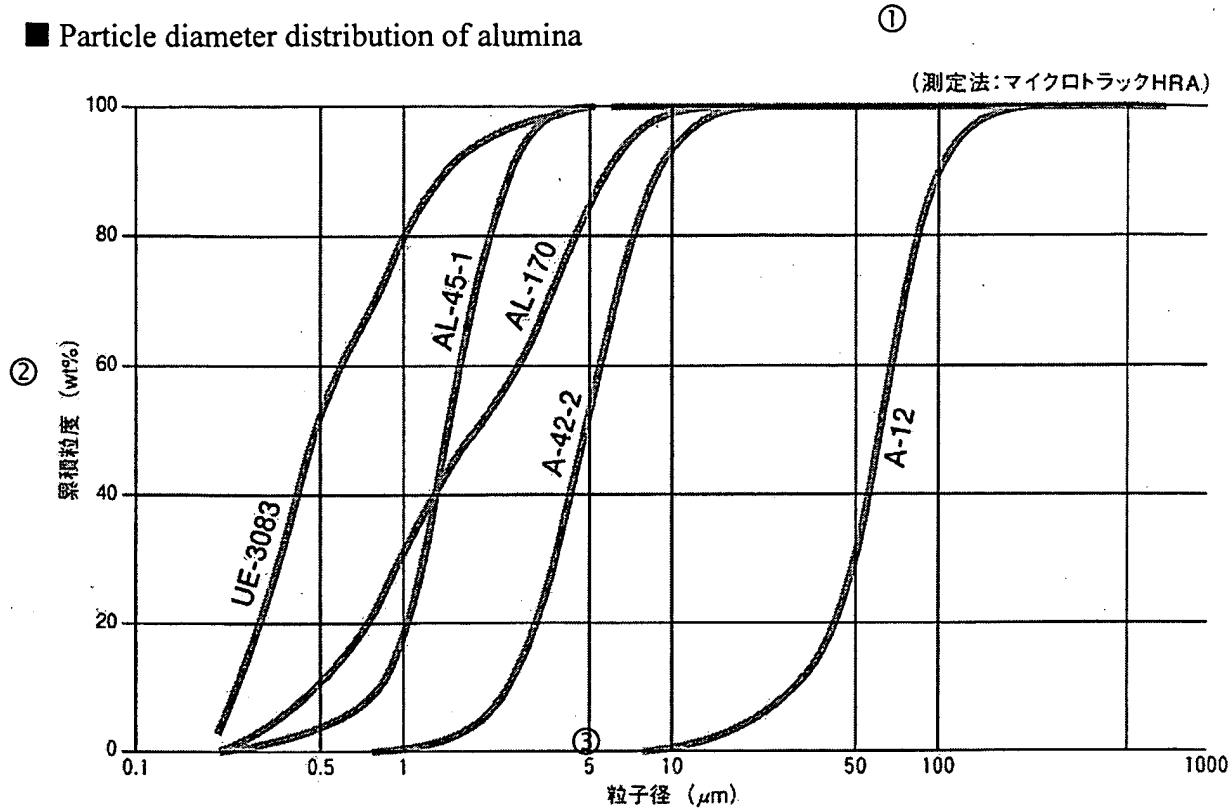
■ Characteristics of α-alumina

①鉱物名	コランダム②	③誘電率	C∥	11.5	at25°C	
④結晶系	⑤六方晶系 a:4.67、c:13.00 ×10⁻¹⁰m		C⊥	9.3	10¹–10¹⁰ Hz	
⑥真比重	3.98	⑦耐電圧		4.8×10⁵ V/cm		
⑧融点	2053°C	⑨体積固有抵抗		10¹⁵Ω/cm		
⑩熱伝導率	36J/m·sec·°C	⑪屈折率		1.76		
⑫比熱	750J/kg·°C	⑬硬度	モース⑭	12		
⑯熱膨張係数 C∥	6.6×10⁻⁶/°C		ビッカース⑮	2.2×10⁴ MPa		
C⊥	5.3×10⁻⁶/°C	⑰ヤング率		4.7×10⁵ MPa		
⑱誘電正接	1×10⁻³ at10³Hz	⑲圧縮強さ		2940 MPa		

⑳ 既存化学物質番号(化審法) 1-23

Key:
1 Name of mineral
2 Corundum
3 Dielectric constant
4 Crystal system
5 Hexagonal crystal a: 4.67, c: 13.00 x 10^{-10} m
6 True specific density
7 Voltage breakdown
8 Melting point
9 Volume specific resistance
10 Thermal conductivity
11 Refractive index
12 Specific heat
13 Hardness
14 Moh
15 Vicker
16 Coefficient of thermal expansion
17 Young's ratio
18 Dielectric loss tangent
19 Compression strength
20 Existing Chemical Substance No. (Chemical Examination method) 1-23

■ Particle diameter distribution of alumina



Key: 1 (measurement method: Micro-track HRA)
2 Accumulated grain size (wt%)
3 Particle diameter (μm)

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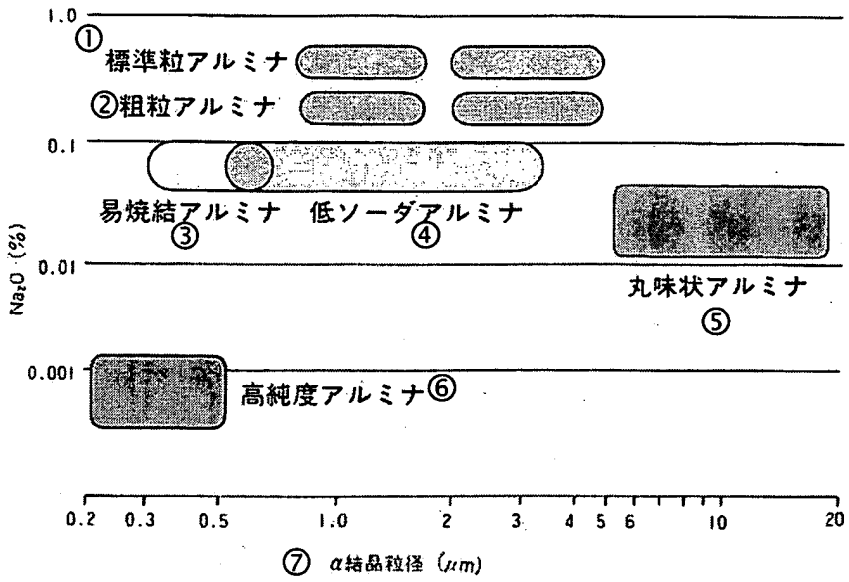
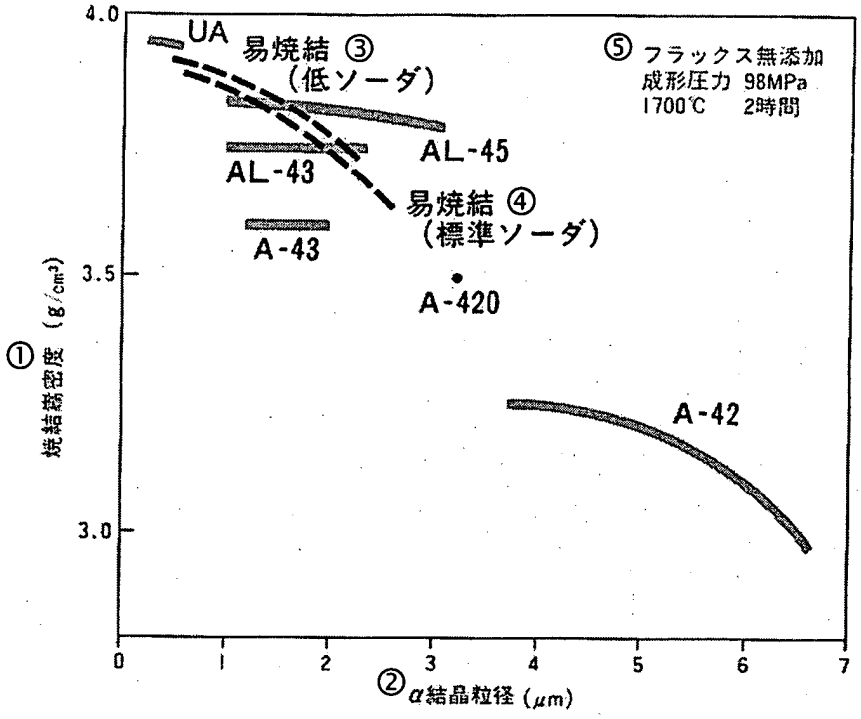
Calcined Alumina

■ Positioning of different alumina products



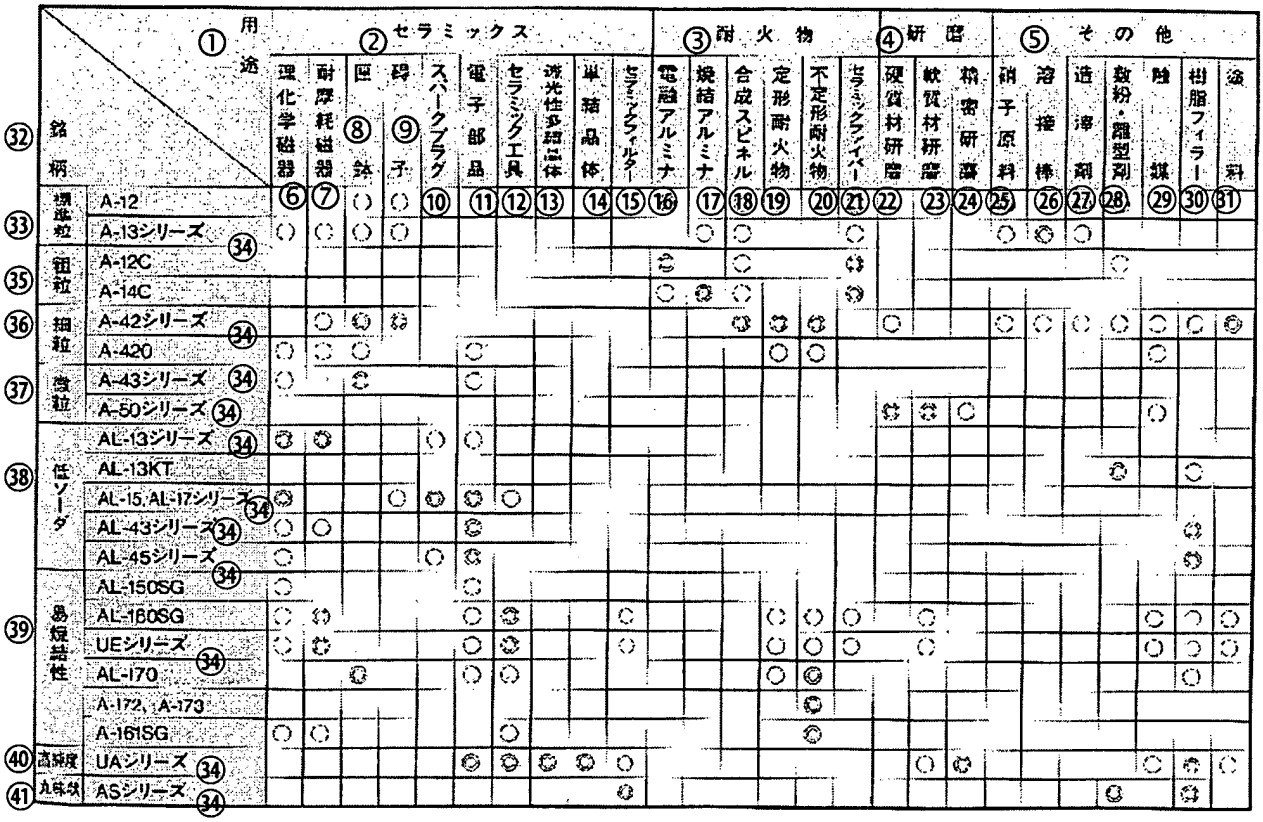
Key:
1 Standard grain alumina
2 Coarse alumina
3 Easy-to-sinter alumina
4 Low sodium alumina
5 Spherical alumina
6 Ultra-high purity alumina
7 Particle diameter of α-crystal (μm)

■ Sintering characteristics of different alumina products



Key:
1 Sintering bulk density (g/cm^3)
2 α-crystal particle diameter (μm)
3 Easy-to-sinter (low sodium)
4 Easy-to-sinter (standard sodium)
5 Without flux
Molding pressure 98 MPa
1700°C 2 h

■ Applications of alumina



Key:
1 Applications
2 Ceramic
3 Fireproofing
4 Abrasive
5 Other
6 Physical and chemical ceramics
7 Wear-resistant ceramics
8 Crucibles
9 Glass
10 Spark plugs
11 Electronic parts
12 Ceramic tools
13 Translucent monocrystal material
14 Monocrystals
15 Ceramic filters
16 Electromelting alumina
17 Sintered alumina
18 Synthetic spinel
19 Formatted fireproofing material
20 Amorphous fireproofing material
21 Ceramic fibers

22 Abrasive for hard material
23 Abrasive for soft material
24 Precision polishing
25 Glass raw material
26 Electrode
27 Ceramic making agent
28 Dusting powder and release agent
29 Catalyst
30 Resin filler
31 Paint
32 Description
33 Standard grain
34 _ series
35 Coarse grain
36 Fine grain
37 Ultra-fine grain
38 Low sodium
39 Easy-to-sinter
40 Ultra-high purity
41 Spherical

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ULTRA HIGH PURITY ALUMINA

The ultra-high purity alumina of our firm is a highly pure product with an Al_2O_3 content of 99.995% or higher and the particle diameter of the uniform ultra-fine powder is in the submicron range, and a sinter having superior surface smoothness, uniformity, high strength and high density can be produced at a low sintering temperature. Furthermore, superior functioning based on the ultra high purity and ultra-fine powder texture is achieved in a variety of fields.

■ Applications

(1) Translucent porcelain: High-pressure sodium lamp arc tubes, EP-ROM window

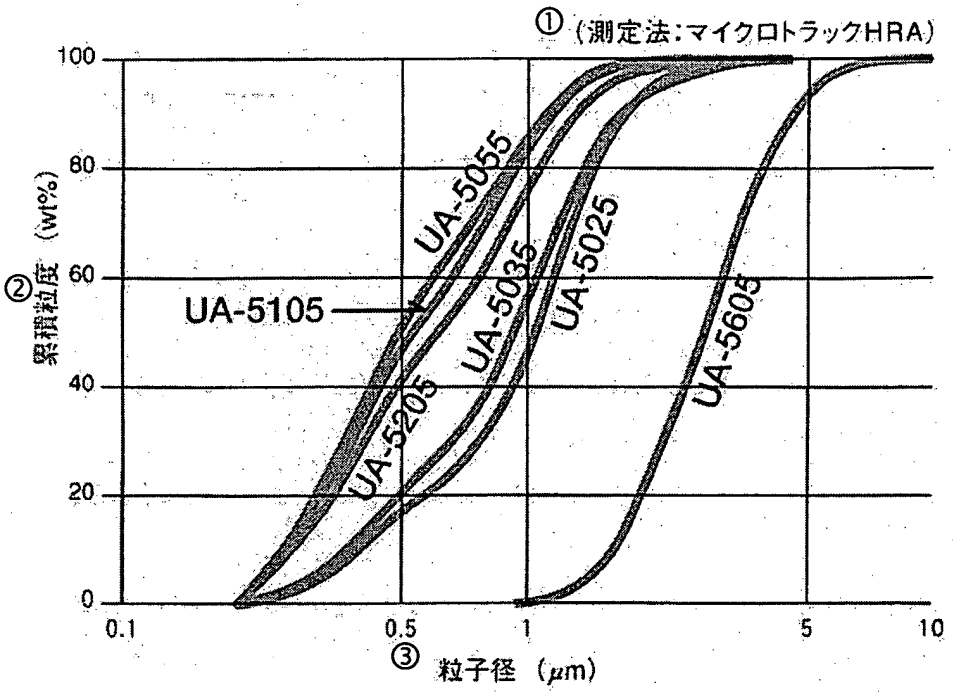
(2) Monocrystals: sapphire, ruby, YAG

(3) High strength alumina ceramics: IC boards, IC packages, cutting tools, high-purity crucibles, thread guides, sputtering targets

(4) Abrasives: abrasives for glass, metals, semiconductors, and plastics, magnetic tapes, abrasive tapes

(5) Other: Deposition materials, fluorescent materials, special glass materials, composite materials, resin fillers

■ Particle diameter distribution of ultra-high purity alumina



Key: 1 (Measurement method: micro-track HRA)
2 Cumulative grain size (wt%)
3 Particle diameter (μm)

■ Chemical analysis value (representative value, common grade)

(units: ppm)

Na	K	Ca	Mg	Fe	Si	Ga	Cr
12	7	1	1	3	8	2	1

■ Quality representative value

④品質項目 ＼ ①品名	②未粉砕品 UA-5050	②未粉砕品 UA-5100	③粉砕品 UA-5035	③粉砕品 UA-5055	③粉砕品 UA-5105	③粉砕品 UA-5205	③粉砕品 UA-5605
⑤結晶形	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	α-Al_2O_3	γ-Al_2O_3
⑥BET比表面積(m²/g)	5	10	3	5	10	20	60
⑦真比重	3.95	3.88	3.97	3.95	3.88	3.80	3.50
⑧嵩密度(g/cm³) 軽⑨装	0.4	0.3	0.5	0.5	0.4	0.3	0.2
⑧嵩密度(g/cm³) 重⑩装	0.8	0.7	1.1	1	0.9	0.7	0.4
⑪加圧嵩密度(g/cm³)	1.83	1.80	2.00	1.96	1.90	1.72	1.20
⑫結晶粒子径(μm)	0.3	0.25	0.4	0.3	0.3	0.1	0.05
⑬粒度分布 平均粒子径(μm) ⑭	—	—	0.9	0.5	0.5	0.6	2.8
⑬粒度分布 5μm(%)	—	—	100	100	100	100	97
⑬粒度分布 3μm(%)	—	—	99	100	100	100	62
⑬粒度分布 2μm(%)	—	—	98	100	100	100	57
⑬粒度分布 1μm(%)	—	—	93	99	99	97	22
⑬粒度分布 0.5μm(%)	—	—	55	84	82	75	0
⑮吸油量(mℓ/100g)	—	—	15	23	23	40	63
⑯焼結試験 MgO 500ppm⑰添加 線収縮率(%) ⑱	—	—	19.1	20.1	21.0	—	—
⑯焼結試験 MgO 500ppm⑰添加 嵩密度(g/cm³) ⑧	—	—	3.92	3.96	3.96	—	—
⑯焼結試験 アルミナ単⑲味 線収縮率(%) ⑱	—	—	18.9	19.9	20.8	—	—
⑯焼結試験 アルミナ単⑲味 嵩密度(g/cm³) ⑧	—	—	3.88	3.92	3.94	—	—

⑳ *1600℃ 2時間焼成

Key:
1 Product name
2 Non-pulverized product
3 Pulverized product
4 Quality item
5 Form of crystal
6 BET specific surface area (m^2/g)
7 True specific gravity
8 Bulk density (g/cm^3)
9 Light packing
10 Dense packing
11 Bulk density under pressure (g/cm^3)
12 Crystal particle diameter (μm)
13 Particle diameter distribution
14 Mean particle diameter
15 Oil absorption (mL/100 g)
16 Sintering test
17 MgO 500 ppm added
18 Linear shrinkage factor (%)
19 Pure alumina
20 Sintered at 1600°C for 2 h

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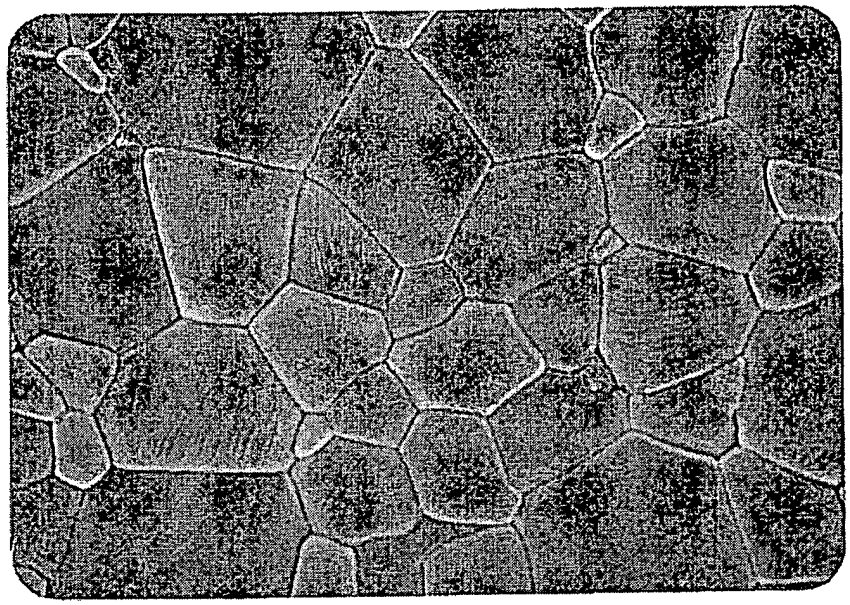
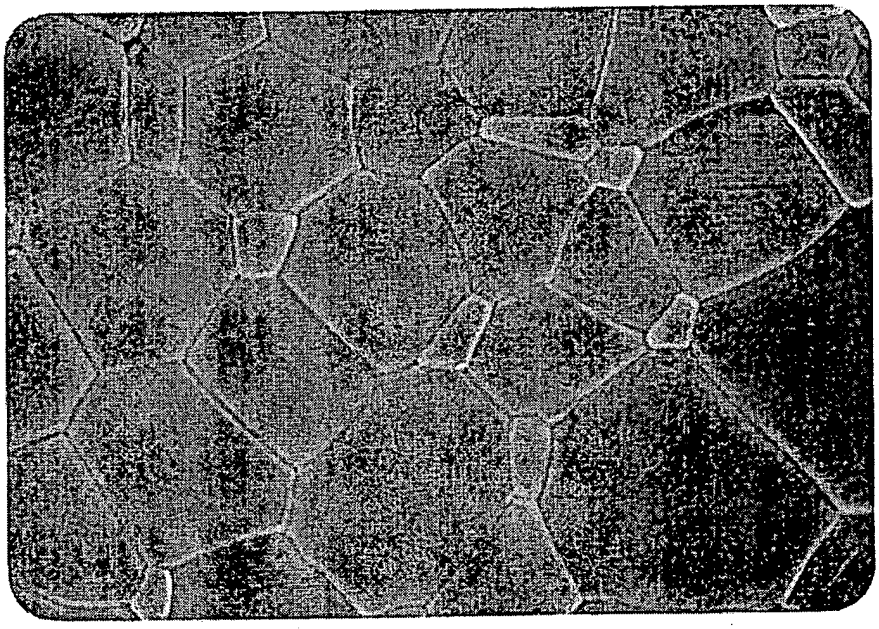
Ultra High Purity Alumina

■ Sinter structure



UA-5055

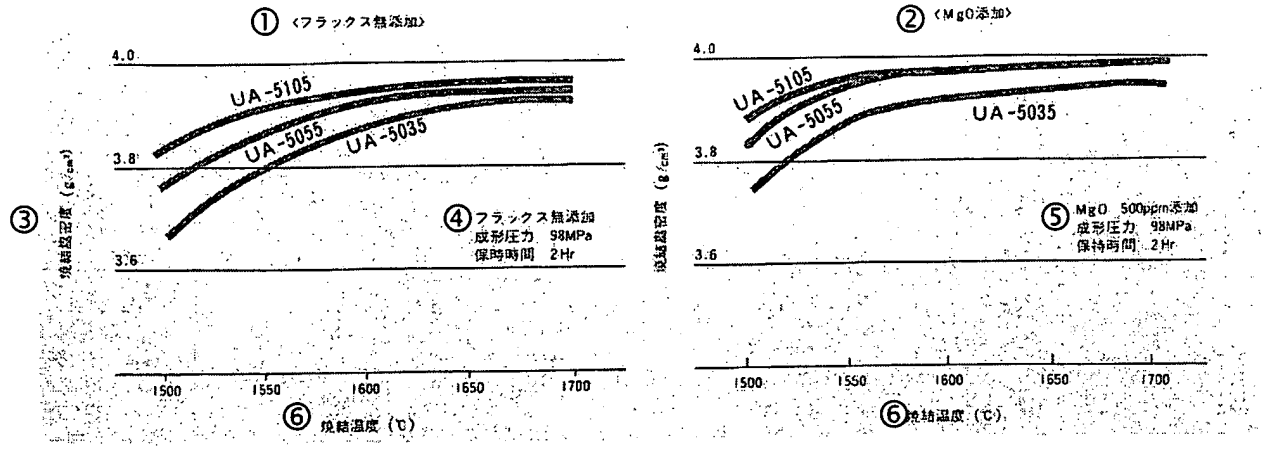
Pure alumina retained for 2 h at 1600°C 5μm



UA-5105

Pure alumina retained for 2 h at 1600°C 5μm

■ Sintering characteristics of ultra-high purity alumina



Key: 1 <Without flux>
2 <MgO added>
3 Sintering bulk density (g/cm^3)
4 Without flux
Molding pressure 98 MPa
Retention time 2 h
5 500 ppm of MgO added
Molding pressure 98 MPa
Retention time 2 h
6 Sintering temperature (°C)